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(54) Title of Invention: A Photoelectric Converter

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SPECIFICATION

1. TITLE OF THE INVENTION

A Photoelectric Converter

2. CLAIM

A photoelectric converter, wherein the photoelectric converter detects patterns on printed documents from reflected light using photoimage sensors with scanning functions and sensitivity to a plurality of wavelengths, and wherein the standard light reflection plate is disposed in the scanning area of the image sensors so as to reflect the standard light and reflect different wavelengths in the scanning position when a detectable object is not present.

3. DETAILED DESCRIPTION OF THE INVENTION

(Object of the Present Invention)

(Industrial Field of Application)

The present invention pertains to a photoelectric converter used to photoelectrically convert and read images of scanned documents such as notes of paper currency.

(Prior Art)

Photoelectric converters of the prior art are used to detect printed patterns on printed documents and identify the type of printed document as shown in FIG 7.

In FIG 7, a specific field is illuminated by a light source 71, and the light reflected from the object in the field is captured by a color line sensor 73 by way of a photographic lens 72.

The printed document 74 is sandwiched between the belts 75, moved into the field at a specific speed in direction x, and scanned by the color line sensor 73 in direction y. The printed document is scanned in two dimensions and signals are obtained.

The RGB color component is contained in the output signals from the color line sensor 73, and these are processed separately from the printed pattern (not shown).

Here, a photoelectric converter is used to reliably detect and identify the printed pattern.

The photoelectric converter has to (1) detect and compensate for changes in signal amplitude due to lamp deterioration or dust, (2) automatically detect dust on the optics or sensors, and (3) detect the edges of the printed document for signal processing. In order to perform these functions, a standard light reflection plate 74 is ordinarily disposed in the scanning field.

The standard light reflection plate 74 shown in FIG 8 is most often used in the prior art. The center of a piece of highly reflective opal glass 74a is disposed in the middle of the scanning area as shown by arrow y. Both ends 74b are processed with black plating to reduce the reflectivity.

The scanning signals are the signals shown in FIG 10 (a). In order to perform function (1), the voltage in the center I is sampled when printed document is absent. The voltage is supplemented for AGC use. The detection of high voltage in the scanning signals on both ends II, III (dotted lines) is used to detect the edges for function (3). The detection of low voltage in the scanning signals from the center of the

scanning field is used to detect dust contamination for function (2). However, because there is no detection of signal voltage on both ends of the field, dust contamination cannot be detected in these areas.

The standard light reflection plate 74 is also used as shown in FIG 9. In this case, highly reflective opal glass 74c is disposed over the entire scanning direction y. This standard light reflection plate satisfies functions (1) and (2), but cannot detect the edges of the printed document to satisfy function (3) because the voltage from the entire field is highly angular as shown in FIG 10 (b).

(Problem Solved by the Invention)

Photoelectric converters of the prior art are able to detect the edges of printed documents but cannot automatically detect all changes in scanning signals and cannot detect all attached dust. As a result, these devices cannot accurately detect all scanning signals.

(Configuration of the Present Invention)

(Means of Solving the Problem)

The present invention is a photoelectric converter, in which the photoelectric converter detects patterns on printed document from reflected light using photoimage sensors with scanning functions and sensitivity to a plurality of wavelengths, and in which the standard light reflection plate is disposed in the scanning area of the image sensors so as to reflect the standard light and reflect different wavelengths in the scanning position when a detectable object is not present.

(Operation)

Because the voltage of all scanning signals with wavelengths outside the specific scanning location is detected, the present inventi n is able to sample portions and use standard AGC signals. The scanning signals with wavelengths from which voltage cannot be obtained in the specific scanning location can be used to detect the edges of the printed document. Because scanning signals with specific wavelengths are obtained from the entire scanning field, these signals can be used to detect dust contamination.

(Preferred Embodiments)

A preferred embodiment of the present invention is shown in FIG 1 through FIG 6. In FIG 1, a specific field is illuminated by a light source 11, and the light reflected from the object in the field is captured by a color line sensor 13 by way of a photographic lens 12. The printed document 14 is sandwiched between the belts 15, moved into the field at a specific speed in direction x, and scanned by the color line sensor 13 in direction y. The printed document is scanned in two dimensions and signals are obtained. The RGB color component is contained in the output signals from the color line sensor 13. These are amplified to a specific voltage by amplifier 14, separated into R, G and B color signals by the color separating circuit 15, and used by the identifier 16 if necessary to determine the printed pattern.

A timing sensor 17 is disposed along the conveyance route of the printed document to detect the arrival of the printed document. The output from the timing sensor 17 is supplied to the timing control circuit 18. The timing control circuit 18 controls the operation of the line sensor 13, the color separating circuit 15 and the control circuit 16 [sic] based on signals from the timing sensor 17.

The control circuit 16 [sic] finds the edges of the printed document, detects the pattern, and determines the type of printed document. It also determines whether there is any dust on the optics. In other words, the identifier 16 is connected to the standard signal generator 17 [sic]. In a specific period of time after the timing sensor 17 detects the arrival of a printed document (from the arrival of the printed document in

the scanning field to the departure of the printed document from the scanning field), the printed document is identified based on the standard signals from the standard signal generator 17 [sic].

When there is no note of paper currency in the scanning field, the presence of dust on the optics can be detected using the output from the timing sensor 17.

FIG 2 and FIG 3 are used to explain the configuration of the standard light reflection plate 21. A sheet of opal glass 23 that can reflect all R (red), G (green) and B (blue) wavelengths detectable by the color line sensor shown in FIG 4 is disposed on a metal base 22. Sharp cut filters 24 with transmittivity properties A shown by the dotted line in FIG 4 are disposed on both ends of the opal glass 23 to reflect light in the R, G and B wavelengths from the center of the y-direction scanning field shown by the arrow. Only light in the R wavelength is reflected from both edges of the y-direction scanning field to the R, G, and B color line sensor.

When the color line sensor scanning signals are separated into R, G and B color sensors, the signals shown in FIG 5 and FIG 6 are obtained.

FIG 5 shows the signals that are obtained when there is nothing in the scanning field. FIG 6 shows the signals from a printed document P in the scanning field as indicated by the dotted lines in FIG 2.

As shown in FIG 5, R (red) signals can be obtained for the entire scanning field when there is no printed document in the scanning field. The properties of the sharp cut filters 24 allow G (green) and B (blue) signals to be obtained only in the center of the scanning field.

Also, as shown in FIG 6, all of the R, G, B signals are obtained for the printed document.

The following is an explanation of the operation of this configuration.

The timing control circuit 18 sets the gain controls for the amplifier 14 based on the output from the timing sensor 14 [sic]. When there is no printed document in the scanning field as shown in FIG 1, the color signals in the center are sampled and detected during period "1" by the AGC sampler (AGT) in the AGC circuit 18 [sic]. The SGC circuit 17 controls the gain of the amplifier 14 so as to maintain a specific voltage for the output from the amplifier 14.

In the detection of dust contamination, the timing sensor control circuit 18 commands the identifier 16 to identify dust contamination when there is no printed document in the scanning field as shown in FIG 1. The control circuit 16 [sic] compares the R scanning signals to the contamination detection level (Ld) from the standard signal generator 17 [sic]. The presence of dust is detected when $R < Ld$ in contamination detection zones I, II and III.

The detection of the edges of a printed document is performed once a note of paper currency has arrived in the scanning area based on commands from the timing control circuit 18. The identifier 16 binarizes the B (blue) scanning signals using the edge detection level (Le) outputted from the standard signals generator 17 [sic]. The edges of the printed document are determined when binary signal Ba goes from "0" to "1" or from "1" to "0" in edge detection zones (4) and (5).

As a result, the functions demanded of a photoelectric converter can be satisfied by using a standard light reflection plate with a simple configuration.

In this preferred embodiment, B (blue) signals are used to detect the edges of printed documents. In this case, it was assumed that the edges of the document would have relatively high reflectivity because of the absence of print on the edges. If the edges of the document have relatively low reflectivity because of the presence of print on the edges, R signals can be used instead of B signals.

In this preferred embodiment, R signals were used on both edges of the scanning field. However, signals of another wavelength can also be used.

In this configuration, sharp cut filters were disposed on opal glass, and the transmittivity properties of the filters were used to reflect light of a specific wavelength. However, another means can also be used to reflect light of a specific wavelength.

(Effect of the Invention)

As explained above, the present invention can accurately detect the edges of scanned objects and detect dust contamination using a simple configuration.

4. BRIEF EXPLANATION OF THE DRAWINGS

FIG 1 shows the configuration of the photoelectric converter of the present invention. FIG 2 is a planar view of the standard reflection plate in FIG 1. FIG 3 is a lateral view of the standard light reflection plate in FIG 2. FIG 4 is a graph used to explain the characteristics of the sharp cut filters. FIG 5 and FIG 6 are output signals used to explain the operation of the photoelectric converter. FIG 7 shows a photoelectric converter of the prior art. FIG 8 and FIG 9 are planar views of a standard light reflection plate of the prior art. FIG 10 shows output signals used to explain the operation of a photoelectric converter of the prior art.

11 ... light source, 12 ... standard light reflection plate, 13 ... color line sensor

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FIG 1

FIG 2

FIG 3

FIG 4

[x-axis] wavelength (nm)

[y-axis] relative sensitivity / transmittivity (%)

FIG 5

FIG 6

FIG 7

FIG 8

FIG 9

FIG 10